

**WHAT IS CLAIMED IS:**

1. A method for routing packets in a router, the method comprising:  
receiving a plurality of packets in a first order;  
storing said plurality of packets in a packet reorder buffer; and  
forwarding said plurality of packets in a second order from said packet reorder  
buffer.

2. The method of claim 1, further comprising:  
determining a plurality of hash values using information contained in said  
plurality of packets;  
storing said plurality of hash values in said packet reorder buffer; and  
using said plurality of hash values to determine said second order.

3. The method of claim 2, wherein a first subset of said plurality of  
packets having a common hash value is forwarded in an order in which said first  
subset is received by said router.

4. The method of claim 2, wherein said hash value is determined using a  
destination address of said plurality of packets.

5. The method of claim 2, wherein said hash value is determined using a  
source address of said plurality of packets.

6. The method of claim 2, wherein said hash value is determined using a  
protocol used by said plurality of packet.

1           7.       The method of claim 2, wherein said hash value is determined using an  
2 address of at least one incoming port used by said plurality of packets.

3           8.       The method of claim 2, wherein said hash value is determined using an  
4 address of at least one outgoing port used by said plurality of packets.

5           9.       The method of claim 2, further comprising:  
6 setting a status of said plurality of packets in said packet reorder buffer to  
7 'not-ready'.

8           10.      The method of claim 8, further comprising:  
9 selecting a 'head of line' packet from said packet reorder buffer, said 'head of  
10 line' packet is a packet that is stored in said packet reorder buffer for  
11 longest period of time; and  
12 identifying said 'head of line' packet using a 'head of line' pointer.

13          11.      The method of claim 10, wherein said 'head of line' pointer is a  
14 software based pointer.

15          12.      The method of claim 10, wherein said 'head of line' pointer is a  
16 hardware-based pointer.

17          13.      The method of claim 10, further comprising:  
18 locating a routing information for said plurality of packets in a cache;  
19 if said routing information is not located in said cache,  
20 locating said routing information in a lookup table; and  
21 when said routing information is located, setting said status of said plurality of  
22 packets in said packet reorder buffer to 'ready'.

1           14.      The method of claim 13, further comprising:  
2 selecting a first packet with a 'ready' status from said packet reorder buffer;  
3 determining whether said first packet is 'head of line' packet.

1        15.    The method of claim 14, further comprising:  
 2        if said first packet is 'head of line' packet,  
 3                removing said first packet from said packet reorder buffer,  
 4                forwarding said first packet, and  
 5                if said packet reorder buffer is not empty,  
 6                        moving said 'head of line' pointer to one of said plurality of  
 7                        packets that is stored for longest period of time in said  
 8                        packet reorder buffer.

1        16.    The method of claim 15, further comprising:  
 2        if said first packet is not said 'head of line' packet,  
 3                locating said 'head of line' packet in said packet reorder buffer,  
 4                determining whether said first packet and said 'head of line' packet  
 5                        have a common hash value, and  
 6                if said first packet and said 'head of line' packet have a common hash  
 7                        value,  
 8                        selecting a second packet with a 'ready' status from said packet  
 9                        reorder buffer.

1        17.    The method of claim 16, further comprising:  
 2        if said first packet and said 'head of line' packet do not have a common hash  
 3                value,  
 4                identifying a second subset of said plurality of packets having a  
 5                        common hash value with said first packet from said packet  
 6                        reorder buffer,  
 7                determining whether said first packet is stored for longest period of  
 8                        time in said packet reorder buffer among said second subset of  
 9                        said plurality of packets, and  
 10                if said first packet is not stored for longest period of time in said packet  
 11                        reorder buffer among said second subset of said plurality of  
 12                        packets,  
 13                        selecting a third packet with a 'ready' status from said packet  
 14                        reorder buffer.

1 18. The method of claim 17, further comprising:  
 2 if said first packet is stored for longest period of time among said second  
 3 subset of said plurality of packets in said packet reorder buffer,  
 4 determining whether a predetermined number of packets have been  
 5 forwarded ahead of said 'head of line' packet from said packet  
 6 reorder buffer.

1 19. The method of claim 18, further comprising:  
 2 if a predetermined number of packets have not been forwarded ahead of said  
 3 'head of line' packet from said packet reorder buffer,  
 4 forwarding said first packet.

1 20. The method of claim 19, further comprising:  
 2 if said predetermined number of packets have been forwarded ahead of said  
 3 'head of line' packet from said packet reorder buffer,  
 4 generating an error, and  
 5 waiting until said 'head of line' packet is forwarded.

1 21. The method of claim 18, wherein said predetermined threshold is  
 2 defined during a provisioning of said router.

1 22. The method of claim 18, wherein said predetermined threshold is  
 2 dynamically calculated by said router.

1 23. The method of claim 20, wherein said head-of-line packet is forwarded  
 2 before said routing information for said 'head of line' packet is located.

1 24. A packet reordering system comprising:  
 2 a packet reorder buffer; and  
 3 a 'head-of-line' pointer.

1           25.    A network element comprising the packet reordering system of claim  
2 24, further comprising:

3           a packet receiving unit coupled to said packet reordering system, said packet  
4           receiving unit is configured to receive a plurality of packets.

1           26.    The network element of claim 25, further comprising:  
2           a packet forwarding unit coupled to said packet reordering system, said packet  
3           forwarding unit is configured to forward said plurality of packets.

1           27.    The network element of claim 26, further comprising:  
2           a processor coupled to said packet reordering system, said processor  
3           configured to  
4           determine a plurality of hash values using information contained in  
5           said plurality of packets, and  
6           store said plurality of hash values and said plurality of packets in said  
7           packet reorder buffer.

1           28.    The network element of claim 27, further comprising:  
2           a network interface coupled to said processor.

1           29.    The network element of claim 28, wherein said network interface  
2           comprising said packet receiving and said packet forwarding units.

1           30.    The network element of claim 27, further comprising:  
2           a memory coupled to said processor, said memory stores a lookup table.

1           31.    The network element of claim 28, further comprising:  
2           a cache coupled to said processor.

32. A network element comprising:  
a processor; said processor is configured to  
receive a plurality of incoming packets in a first order;  
separate said plurality of incoming packets into a plurality of subsets of  
incoming packets;  
forward said plurality of subsets of incoming packets in a second order.

33. The network element of claim 32, wherein said plurality of incoming  
packets is separated according to a plurality of characteristics of said plurality of  
incoming packets.

34. The network element of claim 32, wherein incoming packets in each  
one of said plurality of subsets of incoming packets are forwarded in an order that the  
incoming packets are received.

35. The network element of claim 33, wherein one of said plurality of  
characteristics is a destination address of said plurality of incoming packets.

36. The network element of claim 33, wherein one of said plurality of  
characteristics is a source address of said plurality of incoming packets.

37. The network element of claim 33, wherein one of said plurality of  
characteristics is a protocol used by said plurality of incoming packets.

38. The network element of claim 33, wherein one of said plurality of  
characteristics is an address of at least one incoming port used by said plurality of  
incoming packets.

39. The network element of claim 33, wherein one of said plurality of  
characteristics is an address of at least one outgoing port used by said plurality of  
incoming packets.

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1 40. A network element for routing packets in a router comprising:  
 2 means for receiving a plurality of packets in a first order;  
 3 means for storing said plurality of packets in a packet reorder buffer; and  
 4 means for forwarding said plurality of packets in a second order from said  
 5 packet reorder buffer.

1 41. The network element of claim 41, further comprising:  
 2 means for determining a plurality of hash values using information contained  
 3 in said plurality of packets;  
 4 means for storing said plurality of hash values in said packet reorder buffer;  
 5 and  
 6 means for using said plurality of hash values to determine said second order.

1 42. The network element of claim 41, wherein a first subset of said  
 2 plurality of packets having a common hash value is forwarded in an order in which  
 3 said first subset is received by said router.

1 43. The network element of claim 41, wherein said hash value is  
 2 determined using a destination address of said plurality of packets.

1 44. The network element of claim 41, wherein said hash value is  
 2 determined using a source address of said plurality of packets.

1 45. The network element of claim 41, wherein said hash value is  
 2 determined using a protocol used by said plurality of packet.

1 46. The network element of claim 41, wherein said hash value is  
 2 determined using an address of at least one incoming port used by said plurality of  
 3 packets.

1 47. The network element of claim 41, wherein said hash value is  
 2 determined using an address of at least one outgoing port used by said plurality of  
 3 packets.

1        48.     The network element of claim 41, further comprising:  
2        means for setting a status of said plurality of packets in said packet reorder  
3        buffer to 'not-ready'.

1        49.     The network element of claim 47, further comprising:  
2        means for selecting a 'head of line' packet from said packet reorder buffer,  
3        said 'head of line' packet is a packet that is stored in said packet  
4        reorder buffer for longest period of time; and  
5        means for identifying said 'head of line' packet using a 'head of line' pointer.

1        50.     The network element of claim 49, wherein said 'head of line' pointer is  
2        a software based pointer.

1        51.     The network element of claim 49, wherein said 'head of line' pointer is  
2        a hardware-based pointer.

1        52.     The network element of claim 49, further comprising:  
2        means for locating a routing information for said plurality of packets in a  
3        cache;  
4        means for locating said routing information in a lookup table if said routing  
5        information is not located in said cache; and  
6        means for setting said status of said plurality of packets in said packet reorder  
7        buffer to 'ready' when said routing information is located.

1        53.     The network element of claim 52, further comprising:  
2        means for selecting a first packet with a 'ready' status from said packet  
3        reorder buffer;  
4        means for determining whether said first packet is 'head of line' packet.



54. The network element of claim 53, further comprising:  
means for removing said first packet from said packet reorder buffer if said  
first packet is 'head of line' packet;  
means for forwarding said first packet if said first packet is 'head of line'  
packet if said first packet is 'head of line' packet; and  
means for moving said 'head of line' pointer to one of said plurality of  
packets that is stored for longest period of time in said packet reorder  
buffer if said packet reorder buffer is not empty.

55. The network element of claim 54, further comprising:  
means for locating said 'head of line' packet in said packet reorder buffer if  
said first packet is not said 'head of line' packet;  
means for determining whether said first packet and said 'head of line' packet  
have a common hash value if said first packet is not said 'head of line'  
packet; and  
means for selecting a second packet with a 'ready' status from said packet  
reorder buffer if said first packet and said 'head of line' packet have a  
common hash value.

56. The network element of claim 55, further comprising:  
means for identifying a second subset of said plurality of packets having a  
common hash value with said first packet from said packet reorder  
buffer if said first packet and said 'head of line' packet do not have a  
common hash value;  
means for determining whether said first packet is stored for longest period of  
time in said packet reorder buffer among said second subset of said  
plurality of packets if said first packet and said 'head of line' packet do  
not have a common hash value; and  
means for selecting a third packet with a 'ready' status from said packet  
reorder buffer if said first packet is not stored for longest period of  
time in said packet reorder buffer among said second subset of said  
plurality of packets.

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57. The network element of claim 56, further comprising:  
means for determining whether a predetermined number of packets have been  
forwarded ahead of said 'head of line' packet from said packet reorder  
buffer if said first packet is stored for longest period of time among  
said second subset of said plurality of packets in said packet reorder  
buffer.

58. The network element of claim 57, further comprising:  
means for means for forwarding said first packet if a predetermined number of  
packets have not been forwarded ahead of said 'head of line' packet  
from said packet reorder buffer.

59. The network element of claim 58, further comprising:  
means for generating an error if said predetermined number of packets have  
been forwarded ahead of said 'head of line' packet from said packet  
reorder buffer, and  
means for waiting until said 'head of line' packet is forwarded if said  
predetermined number of packets have been forwarded ahead of said  
'head of line' packet from said packet reorder buffer.

60. The network element of claim 57, wherein said predetermined  
threshold is defined during a provisioning of said router.

61. The network element of claim 57, wherein said predetermined  
threshold is dynamically calculated by said router.

62. A computer program for forwarding a packet in a network, encoded in  
computer readable media, said program product comprising a set of instructions  
executable on a computer system, wherein said set of instructions is configured to  
receive a plurality of packets in a first order;  
store said plurality of packets in a packet reorder buffer; and  
forward said plurality of packets in a second order from said packet reorder  
buffer.

63. The computer program product of claim 62, wherein said set of instructions is further configured to:

- determine a plurality of hash values using information contained in said plurality of packets;
- store said plurality of hash values in said packet reorder buffer; and
- use said plurality of hash values to determine said second order.

64. The computer program product of claim 63, wherein a first subset of said plurality of packets having a common hash value is forwarded in an order in which said first subset is received by said router.

65. The computer program product of claim 63, wherein said hash value is determined using a destination address of said plurality of packets.

66. The computer program product of claim 63, wherein said hash value is determined using a source address of said plurality of packets.

67. The computer program product of claim 63, wherein said hash value is determined using a protocol used by said plurality of packet.

68. The computer program product of claim 63, wherein said hash value is determined using an address of at least one incoming port used by said plurality of packets.

69. The computer program product of claim 63, wherein said hash value is determined using an address of at least one outgoing port used by said plurality of packets.

70. The computer program product of claim 63, wherein said set of instructions is further configured to

- set a status of said plurality of packets in said packet reorder buffer to 'not-ready'.

1           71.     The computer program product of claim 69, wherein said set of  
2 instructions is further configured to  
3           select a 'head of line' packet from said packet reorder buffer, said 'head of  
4           line' packet is a packet that is stored in said packet reorder buffer for  
5           longest period of time; and  
6           identify said 'head of line' packet using a 'head of line' pointer.

1           72.     The computer program product of claim 71, wherein said 'head of line'  
2 pointer is a software based pointer.

1           73.     The computer program product of claim 71, wherein said 'head of line'  
2 pointer is a hardware-based pointer.

1           74.     The computer program product of claim 71, wherein said set of  
2 instructions is further configured to:  
3           locate a routing information for said plurality of packets in a cache;  
4           if said routing information is not located in said cache,  
5           locate said routing information in a lookup table; and  
6           when said routing information is located, set said status of said plurality of  
7           packets in said packet reorder buffer to 'ready'.

1           75.     The computer program product of claim 74, wherein said set of  
2 instructions is further configured to  
3           select a first packet with a 'ready' status from said packet reorder buffer;  
4           determine whether said first packet is 'head of line' packet.

1           76.     The computer program product of claim 75, wherein said set of  
2 instructions is further configured to:  
3           if said first packet is 'head of line' packet,  
4           remove said first packet from said packet reorder buffer,  
5           forward said first packet, and  
6           if said packet reorder buffer is not empty,

7 move said 'head of line' pointer to one of said plurality of  
 8 packets that is stored for longest period of time in said  
 9 packet reorder buffer.

1 77. The computer program product of claim 76, wherein said set of  
 2 instructions is further configured to:  
 3 if said first packet is not said 'head of line' packet,  
 4 locate said 'head of line' packet in said packet reorder buffer,  
 5 determine whether said first packet and said 'head of line' packet have  
 6 a common hash value, and  
 7 if said first packet and said 'head of line' packet have a common hash  
 8 value,  
 9 select a second packet with a 'ready' status from said packet  
 10 reorder buffer.

1 78. The computer program product of claim 77, wherein said set of  
 2 instructions is further configured to  
 3 if said first packet and said 'head of line' packet do not have a common hash  
 4 value,  
 5 identify a second subset of said plurality of packets having a common  
 6 hash value with said first packet from said packet reorder  
 7 buffer,  
 8 determine whether said first packet is stored for longest period of time  
 9 in said packet reorder buffer among said second subset of said  
 10 plurality of packets, and  
 11 if said first packet is not stored for longest period of time in said packet  
 12 reorder buffer among said second subset of said plurality of  
 13 packets,  
 14 select a third packet with a 'ready' status from said packet  
 15 reorder buffer.

1           79.    The computer program product of claim 78, wherein said set of  
2 instructions is further configured to  
3           if said first packet is stored for longest period of time among said second  
4           subset of said plurality of packets in said packet reorder buffer,  
5           determine whether a predetermined number of packets have been  
6           forwarded ahead of said 'head of line' packet from said packet  
7           reorder buffer.

1           80.    The computer program product of claim 79, wherein said set of  
2 instructions is further configured to:  
3           if a predetermined number of packets have not been forwarded ahead of said  
4           'head of line' packet from said packet reorder buffer,  
5           forward said first packet.

1           81.    The computer program product of claim 80, wherein said set of  
2 instructions is further configured to  
3           if said predetermined number of packets have been forwarded ahead of said  
4           'head of line' packet from said packet reorder buffer,  
5           generate an error, and  
6           wait until said 'head of line' packet is forwarded.

1           82.    The computer program product of claim 79, wherein said  
2 predetermined threshold is defined during a provisioning of said router.

1           83.    The computer program product of claim 79, wherein said  
2 predetermined threshold is dynamically calculated by said router.